Packaging Pointers: Perishable Shipments

Perishable shipments must be properly packaged to prevent spoilage and maintain product integrity. This packaging leave-behind will help you prepare your perishable shipments for the express shipping environment.

WHAT IS A PERISHABLE SHIPMENT?

The International Air Transport Association (IATA) defines a shipment as perishable if its contents deteriorate over a given period of time if exposed to harsh environmental conditions, such as excessive temperature or humidity. Some examples of perishable shipments include seafood, dairy, plants, meat and fruits, as well as medical and chemical products.

PRESERVING PERISHABLE SHIPMENTS

Perishable products may be subjected to extremes of heat and/or cold on the way to their destination. FedEx does not provide temperature-controlled transportation services. With careful packaging, you can protect your products by providing appropriate temperature protection or stability. Materials most commonly used for this purpose include insulation and coolants/refrigerants.

Insulation

Perishable product should be packaged with enough insulation to prevent or reduce the transfer of heat through the container walls.

The most common insulation materials are:

- Expanded Polystyrene Foam (EPS)
- Rigid High Density Polyurethane
- Reflecting Surface Material (Radiant Barrier Films)

Use insulation materials to:

- Maintain products within known allowable temperature ranges (chemicals, food, medical drugs)
- Keep products frozen (seafood, dairy products, medical specimens, meat)
- Prevent products from freezing (chemicals, blood specimens, seafood)
- Minimize effect of extreme temperature variations (plants, flowers, live lobsters, sensitive electronics, polymers)
- Prevent melting and thawing in hot weather (chocolates, ice cream)

Coolants/Refrigerants

Coolants/refrigerants, such as gel refrigerants and dry ice, keep perishable products cold or frozen. Wet ice (e.g., ice cubes) has many disadvantages, including weight, thawing, leaking, and the need for expensive water-resistant packaging.

The use of wet ice in perishable shipments must be approved in advance by the FedEx Packaging Design and Development Department.

Dry Ice

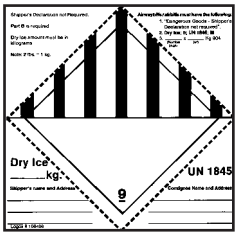
Dry ice, which is a solid form of carbon dioxide, has a surface temperature of -109˚ F (-78˚ C) and is used to help keep products frozen. Because it can change from a solid to gas in transit, space may be created in a package, allowing the product to shift. That's why it's best to place block dry ice in corrugated boxes.

When dry ice changes to carbon dioxide gas in enclosed spaces like aircraft cargo holds, it displaces oxygen. That's why it's a dangerous good for air transport and requires special handling and labeling.

FedEx requires that all dry ice shipments, including those within the U.S., comply with IATA regulations. Some countries don't allow dry ice shipments. Call FedEx International Customer Service at (800)247-4747 for more information on a given country's restrictions.

IATA limits the amount of dry ice per package to 200 kg (400 lbs.). IATA requires the net weight of dry ice to be listed in kilograms and that the shipper use the miscellaneous class 9 label. If an airbill is included, certain airbill notations are required.

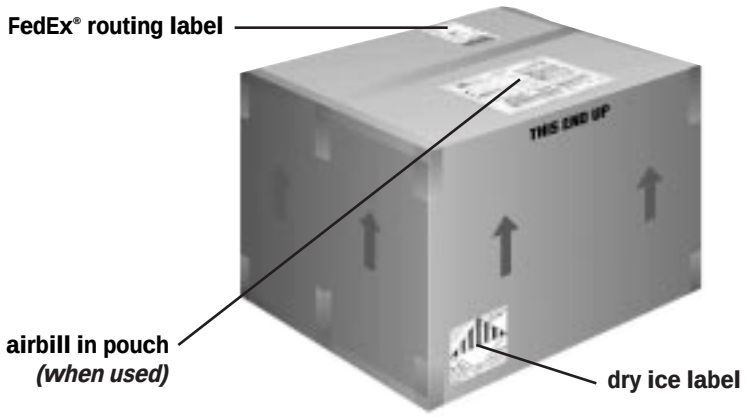
FedEx has designed a "dry ice" label (*see at right*) that satisfies the IATA marking and labeling requirements when accurately completed. Legally required package markings include:



FedEx Dry Ice Label

- "Dry Ice" or "Carbon Dioxide Solid"
- "UN 1845"
- Net quantity of dry ice in kilograms
- Name and address of BOTH the shipper and recipient. (The airbill does not fulfill that requirement)

These labels are provided free of charge; you may order them through our toll free number 1•800•Go•FedEx®, or (800-463-3339).

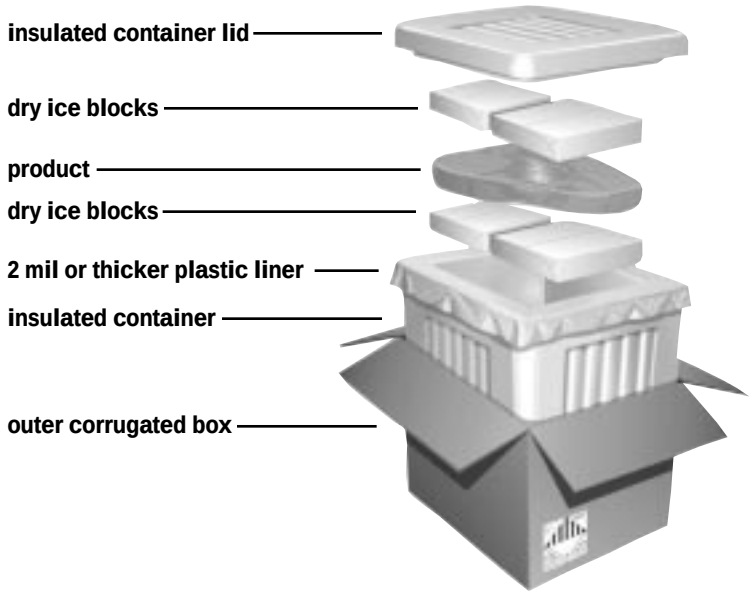


PACKAGING GUIDELINES FOR PERISHABLE SHIPMENTS

- Shipments must be packaged to withstand different orientations
- Use insulating container, e.g., Expanded Polystyrene (EPS) containers with 1-1/2" - to 3" -thick walls. Molded containers work best. The FedEx Packaging Design and Development Department, (800)633-7019 can provide you with a list of suppliers
- Use a refrigerant that will keep products within the required temperature ranges. Gel refrigerants are suitable for refrigerating products within the 30˚ F (-1˚ C) to 60˚ F (16˚ C) range
- EPS containers *must be placed inside* sturdy outer corrugated containers. If you wish to apply for an exemption to ship without an outer box, submit your EPS containers and the products you intend to ship to the FedEx Packaging Design and Development Department, (800)633-7019, for free package testing
- If your perishable products can melt or thaw, or if your shipment contains liquid, you must either *double bag* the products using 2 mil or thicker watertight plastic bags or line the inside of the EPS container with 2 mil or thicker plastic liner and absorbent material
- Shipping perishable products over a weekend is discouraged. We recommend that you package for a minimum of 30 hours transit time for any perishables shipped by FedEx Priority Overnight® or FedEx Standard Overnight®. For FedEx 2 Day®, FedEx 2 Day® Freight and FedEx Express Saver®, you should package shipments for at least 12 hours more than the delivery commitment time

HOW TO KEEP PRODUCTS FROZEN DURING TRANSIT

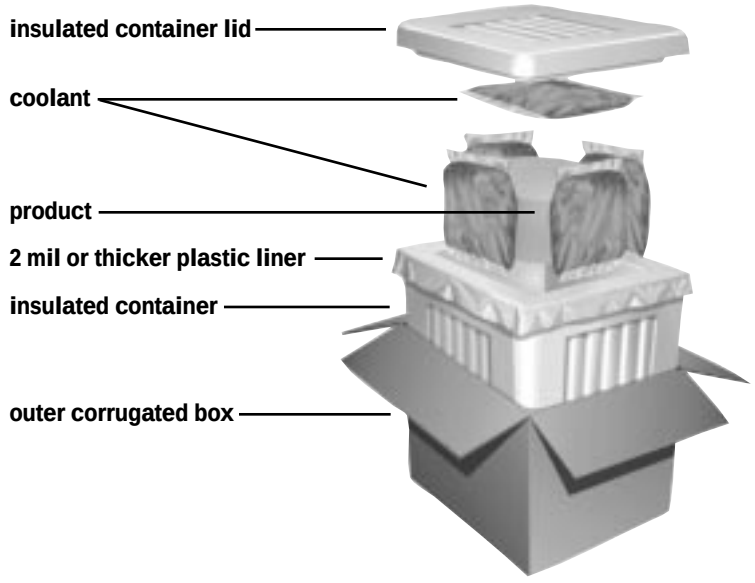
- Freeze products at or below 32˚ F (O˚ C)
- Precool the insulated container
- If the shipment contains liquid or perishable products that can melt or thaw, you must *double bag* the products using 2 mil or thicker watertight plastic bags. An alternative is to line the inside of an EPS container with 2 mil or thicker plastic liner and absorbent material
- Arrange products compactly, but leave space around the products for dry ice. Close the bag securely
- Place dry ice in the corrugated box at the bottom and around the products
- Pack tightly and fill empty air spaces with dunnage
- Place lid over insulated container. Do not seal completely. (Some venting is needed to allow carbon dioxide gas to escape)
- Place closed, insulated container inside an outer corrugated box
- Securely tape corrugated box with pressure-sensitive plastic tape. Complete the required paperwork and labeling



HOW TO KEEP PRODUCTS REFRIGERATED DURING TRANSIT

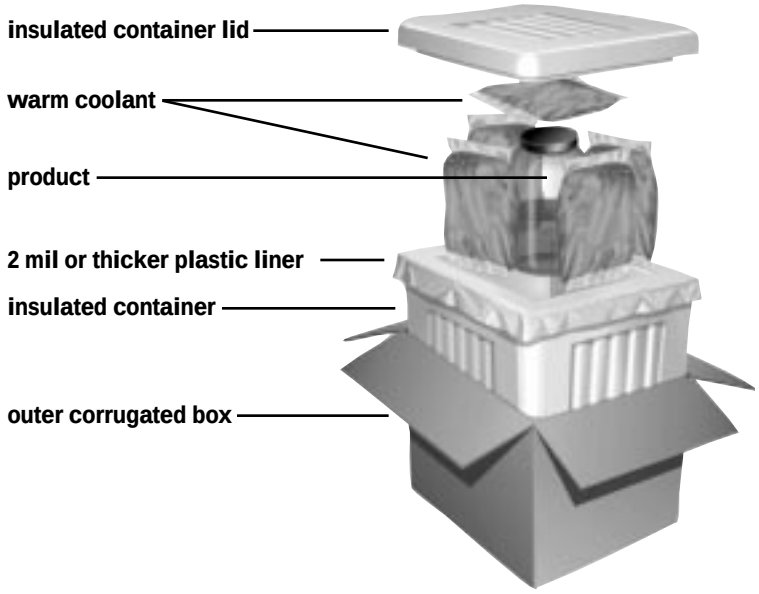
Refrigeration prolongs shelf life by lowering a product's temperature, which delays metabolic deterioration and decay by microorganisms. Chemical coolants (e.g., gel refrigerants) are the refrigerants of choice for most express carriers.

- Freeze the coolants (gel refrigerants) according to manufacturers' guidelines
- Precool the insulated container
- For shipments containing a liquid or perishable products that could melt or thaw, you must *double bag* the products using at a minimum 2 mil watertight plastic bags. Instead of double-bagging your products, you can line the inside of the EPS container with 2 mil or thicker plastic liner and absorbent material
- Arrange products compactly inside the insulated container, allowing space for coolants
- Place sufficient amount of coolants on top of and around the products. Fill all void space with dunnage to prevent product movement
- Close the bag securely
- Close and securely seal the insulated container with pressure-sensitive plastic tape
- Place the insulated container inside a corrugated outer box
- Close and securely seal the corrugated box with pressure-sensitive plastic tape. Apply the same tape over all box flaps and seams to restrict air infiltration



HOW TO PROTECT PRODUCTS FROM FREEZING

You can protect your products from extremely low temperatures and freezing by using heat sinks, which help maintain desired temperatures. A heat sink acts as a "sacrificial system" by absorbing thermal energy to keep it from affecting the products. Chemical refrigerants like gel refrigerants make good heat sinks. To reduce the risk of freezing, place your products inside an insulated container and surround them with unchilled gel refrigerants. If you're working in a cold environment, warm the gel refrigerants to around 68˚ F (20˚ C). Ship the insulated container inside a corrugated box. Use of heat sinks to protect products should be validated to ensure desired performance.



FREQUENTLY ASKED QUESTIONS

Following are the most frequently asked questions about perishable product shipments.

How much dry ice should I use?

The optimal amount of dry ice to keep products frozen depends on several factors, including the product mass, the internal volume of the insulated container, wall thickness and so on. For example, if you're using an EPS container with a 1 1/2-inch-thick wall and maximum volume of 4,725 cubic inches, we recommend 10 lbs. of dry ice for the first 24 hours and five lbs. for each additional three hours. To slow the rate at which dry ice changes to a gas, package the blocks or pellets in either corrugated containers or wrapping paper. Additional dry ice may be needed during hot weather.

How much gel refrigerant do I need?

Your product will stay at a constant temperature if you prevent thermal energy from reaching it. That's why we recommend placing frozen gel refrigerants around products to absorb heat entering from any direction.

TEST PROCEDURES FOR GEL AND DRY ICE

Objective: To determine the optimal amount of coolant (dry ice, gel refrigerant, etc.).

Samples: Products to be shipped, insulated containers, temperature recorders.

Method: Conduct the test in a constant-temperature, draft-free room.

- For each coolant you are going to test, select a number of same size containers
- Package the products in each container as you normally would for shipping
- Place temperature probes in direct contact with the products. If possible, place probes in multiple locations within the container (top, bottom, middle and corner). To prevent false readings, make sure the probes are not in direct contact with the coolants
- Place each container on a scale and load different amounts of coolant (by weight) in each box
- Record temperature of products in each package configuration in 2-4 hour intervals for 48 hours
- Determine which container with coolant is within required temperature range at the end of the test
- For dry ice, record the weight of each box at the same time intervals as the temperature (2-4 hour intervals for 48 hours) to determine the amount of dry ice that sublimated (i.e., changed to gaseous from)

Conclusion: At the end of the test, see which containers successfully kept the products within the required temperature range. For the gel refrigerant tests, the successful container with the least amount of sublimation will determine the minimum amount of dry ice to use.

For a more detailed test method, see ASTM Test Method D3103, "Standard Test Method for Thermal Quality of Packages." (American Society of Testing and Materials, 1916 Race St., Philadelphia, PA 19103.)

What environmental conditions will my products be exposed to during transit?

The variety of products that travel though the FedEx system make it impossible to provide controlled environments to meet the temperature requirements of all products.

When preparing your perishable shipments, take into account both the time of year and the transit location temperatures. Lows can reach -60˚F (-51˚C) in carrier vehicles and open dock areas during the winter in northern climates. Highs can reach 140˚F (60˚C) in closed, parked carrier vehicles during the summer in southern climates. For worldwide

applications, the U.S. military assumes a worst case low of -80˚F (-62˚ C) and a high of 160˚ F (71˚ C).

Depending on the location, weather, and time of day, packages are generally exposed to greater temperature extremes during ground-handling operations than during flight. Packages are generally sorted or processed inside covered buildings under comfortable working conditions, but many areas are wide-open during operations.

Perishable products also face diverse environmental conditions aboard vans, trucks and aircraft.

Vans and Trucks

The outside temperature generally determines the temperature inside the van and cargo areas, so assume that your package will be exposed to various ambient temperatures at different locations. Temperatures inside enclosed vehicles and trucks are generally lower in colder months and higher in warmer months compared to ambient temperatures.

Aircraft

Temperatures on board FedEx aircraft vary depending on the type of aircraft, the location of each cargo compartment with respect to the fuselage, and a package's location within each compartment. Flight length and cruising altitude also affect temperature.

The following temperature ranges for aircraft transportation are provided for general reference only:

Main Cargo Compartment Temperature Ranges

Temperature ranges aboard most wide-body aircraft main cargo compartments may vary between 65˚ F (18˚ C) and 90˚ F (32˚ C).

Lower Cargo and Bulk Compartment Temperature Ranges

In any aircraft bulk compartment, packages positioned next to aircraft outer structure (worst case) may be exposed to temperatures during high altitudes as low as 0 degrees F (-18˚ C).

Aircraft Pressure Ranges

Most FedEx aircraft are pressurized throughout flight to a cabin pressure of approximately 8,000 feet during cruise, which corresponds to a pressure of approximately 11 psi (compared to 14.7 psi at sea level). During aircraft climb and descent, the pressure varies between 14.7 and 11 psi.

Some feeder aircraft, however, are not pressurized because they generally fly at an altitude of 12,000 to 15,000 feet, which corresponds to pressure between 9.3 psi and 8.3 psi.

CUSTOMER RESOURCES

- Perishable and Dry Ice Labels
- List of Perishable Packaging Suppliers
- "How to Pack Seafood for Overnight" brochure
- "Guidelines to Proper Packaging" brochure
- "Guidelines for Blood, Urine and Diagnostic Test Samples" brochure
- "Pointers on Packaging for Flower Shipments" brochure
- FedEx Packaging Design and Development Department (800)633-7019

ADDITIONAL RESOURCES

- Your local Yellow Pages under "Packaging" and "Ice" for packaging suppliers
- "Protecting Perishable Foods During Transport by Truck" (Agricultural Handbook #669, U.S. Department of Agriculture)
- National weather reports on the Internet
- National Climatic Data Center CD-ROM, showing weather patterns throughout the world. Phone 704-271-4800. Internet address: Orders@NCDC.NOAA.GOV5
- "Principles of Cargo Handling and Perishable Cargo Handling Guide" Published by IATA for airline and freight forwarding industries

If you have questions or need more information on dry ice shipment, ask for the FedEx Dangerous Goods Hotline at 1•800•Go•FedEx® (800)463-3339. For more information, advice, or to take advantage of free package testing and design service, call the FedEx Packaging Design and Development Department at (800)633-7019.